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ABSTRACT

During the energy crisis of the early 1970s, there was a drive to conserve energy in every segment of society. Citizens were encouraged to insulate their homes and tighten them up to avoid loss of energy. One of the products to emerge from this crisis was urea formaldehyde foam insulation. (Urea formaldehyde is a well-known agent for preserving school biology specimens.) This construction material became the focus of attention in the scientific community after many complaints from homeowners were lodged against contractors. In hot and humid conditions, the gas is readily released into the atmosphere and may produce a carcinogenic effect in a home, school, or work environment. This article addresses issues having to do with insulation of homes in Canada and the United States, and it suggests procedures within the school health program to combat any harmful effects. Various research projects are discussed along with policy positions of appropriate government agencies in the United States and Canada. (LL)

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# FORMALDAHYDE IN OUR ENVIRONMENT

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Abstract

Formaldehyde, a well-known agent for preserving school biology specimens, is also used to manufacture many household items and goods. In hot and humid conditions it is released into the air and may cause problems in a home or work environment.

The article addresses issues having to do with insulation of homes in Canada and the United States, and it suggests procedures within the school health program to combat the possible harmful effects.

Formaldehyde, the simplest of the organic aldehyde compounds was discovered by August Wilhelm von Hofman, a German chemist in 1867 (The World Book Encyclopedia, 1971). This chemical may have been around since the beginning of the Earth's primitive atmosphere, but to most it is probably most familiar as the solution used to preserve insects and other biological specimens. About six billion tons of this chemical is produced each year (Barner, 1988).

For decades, formaldahyde has been used for disinfecting, embalming, and for making compounds such as urea resins and organic dyes. The plastics industry uses it with carbolic acid to make bakelite. Formacone, or paraformaldehyde, a solid polymer of formaldehyde is used to make fumigating candles (World Book Encyclopedia, 1971).

More recently, formaldehyde has been used to manufacture particle board, plywood, paper, home insulation, leather and agricultural products, permanent press fabrics, preservatives, drugs and cosmetics (Perera and Petito, 1982). Formaldehyde polymers are also found in furniture, upholstery fabrics, draperies, wall coverings, decorative furnishings, furs, carpets, rugs, carpet backing and carpet shampoo (Barner, 1988).

Many of the above mentioned products containing formaldehyde have a distinctive odor. An example of such a product is diesel exhaust (Waldbott, 1978).

In hot and humid conditions, this gas is readily released into the atmosphere. In a home or work environment, it is released

slowly, the half-life possibly being 4.4 years (Barner, 1988).

Over the years, specific health issues have also begun to surface, noting correlation between high formaldehyde exposures and specific illnesses. Formaldehyde attaches itself to particulate matter and in doing so is carried down to alveolar spaces where it produces inflammation (Waldbott, 1978). The outcome might show as tears, sneezing, cough, sensation of suffocation, rapid pulse, headaches, skin diseases, weakness, and changes in the body temperature (Waldbott, 1978) to mention a few. Other suggested complications include nose bleeds, dizziness, vomiting, skin rashes, central nervous system disorders, asthma, insomnia and fatique, depending on smoking habits and genetic disposition of the individual (Barner, 1988).

Is formaldehyde a promoter of today's lifestyles, or is it a bearer of bad tidings? What health related evidence do we have to substantiate health claims? And what are the implications for educational endeavors?

During the energy crisis of the early 1970s, there was a drive to conserve energy in every segment of society. Citizens were encouraged to insulate their homes and tighten them up to avoid loss of energy. One of the products to emerge from this crisis was urea formaldehyde foam insulation. This contruction material became the focus of attention in the scientific community after many complaints from homeowners were lodged against contractors.

The reasons for the development of this kind of insulation was that it was the most reasonable approach financially to conserve

energy in the home. Instead of tearing out interior walls, insulating and replacing those walls, urea formaldehyde foam could be pumped into empty spaces in walls with a minimum financial burden. Many homeowners were also supplied with an incentive to insulate their homes by receiving a tax break from the Federal government. Of the many types of insulation available, some chose contractors who used the urea formaldehyde foam method.

A typical complaint was registered by Mike and Josephine Wagner, a couple in Bayville, New Jersey. No immediate effects were noticed after having their home insulated with urea formaldehyde foam but a few days later there were complaints from visitors in their home which included the son's piano teacher and a neighbor who could not stand the odors and eye irritation. The Wagners, exposed gradually, had failed to notice the smell, but they soon started developing health problems. First their son complained of headaches and watering eyes. The his sister developed the same symptoms. Even the dog became sick. The Wagners called the contractor and were told to open the windows. The odor would be expected to gradually disappear. Instead the effects became worse. Mike Wagner, a school teacher, fainted while in class, and was unable to continue teaching. Today he gets dizzy when he comes in contact with various chemicals. The last time he went to a fast-food restaurant, he passed out and had to be hospitalized. His doctor believes he is reacting to the smell of the plastic carton in which the hamburger is served (Stossel, 1980).

The report and a myriad of other similar cases prompted cancer

researchers to study the effects of formaldehyde on test animals. According to Arthur Upton, Chairman of New York University's (NYU) Institute of Environmental Medicine and former director of the National Cancer Institute, a study performed at NYU provided "decisive confirmation" of industry findings that formaldehyde is an animal carcinogen (Sun, 1981).

A previous experiment at NYU involved a combination of formaldehyde and hydrocholoric acid which caused cancer in rats. Later the chemicals were studied separately and the findings substantiated the original results. Formaldehyde alone caused nasal cancers in 10 of 100 rats exposed to 10.6 and 14.6 parts per million (ppm). No cancers appeared in the controls. According to Upton, the researchers have not observed "a single grossly visible spontaneous nasal cancer in 1920 control rats over a period of 14 years" (Sun, 1981). Some industrial workers are exposed to formaldehyde levels up to 10 ppm.

Information on workers in industry is being collected to try and determine if exposure to formaldehyde is carcinogenic to the human population. Some workers have developed nasal cancers which resembled those found in rats. The Occupational Health and Safety Administration at first agreed with the NYU studies and made a stand on eliminating it from the workplace before changing its policy on the matter. Formaldehyde producers are contesting its ban by saying there have been no epidemiological studies to show it is carcinogenic to humans (Science, 1981).

In the earlier NYU experiments there was no information as to

why formaldehyde caused cancer since the research was primarily for testing its carcinogenicity. A more recent study was undertaken to determine its effect on DNA.

Research involving human cell growth in culture indicates that the chemical formaldehyde (CH2O) may not only inhibit the repair of DNA damage caused by X-rays. Curtis Harris of the National Cancer Institute's Laboratory of Human Carcinogenesis said that the main impetus for this study was to explore whether high concentration of formaldehyde in cigarette smoke may play some role in causing respiratory tract cancers. Although the present data are insufficient to indict CH2O on that charge, they do suggest a mechanism whereby the chemical might act on cells, either alone or with other physical and chemical agents. Harris studied CH2O effects by using two types of bronchial cells which normally line the bronchial surface and fibroblasts which originate in connective tissue.

Cells exposed to CH2O alone developed both single-strand DNA breaks and "DNA protein cross-links" (covalent bonds where CH2O acts as a bridge between DNA and various proteins). The NCI team reported that cross-link frequency was proportional to CH2O concentration.

Their research showed that CH2O impaired the repair of X-ray induced single-strand breaks in DNA. Whether cells were incubated in a solution of CH2O for an hour before or after exposure to 800 rads of X-rays, fewer breaks repaired than in untreated radiation exposed cells (Raloff, 1983).

The most heated controversy to date occured in the Occupational Safety and Health Administration and the Environmental Protection Agency. In the past, the position of these agencies has been to to ban a substance if it was shown to be carcinogenic to animals. In the case of formaldehyde, both agencies have reversed position. Such a position contradicts principles for assessing carcinogenic risk which has been widely accepted by the scientific community over a decade and embodied in policies of regulatory agencies following deliberations of broadbased scientific panels. These principles assert that confirmed positive animal data are presumptive evidence of carcinogenicity in humans; that with current information and methods it is not possible to establish threshold or no-effect levels that can be reliably applied to the human population; and that positive human epidemiological data are not necessary to conclude that a chemical substance poses a significant risk (Perera and Petito, 1982).

The Formaldehyde Institute, an association of formaldehyde producers and users, has advocated that formaldehyde not be regulated by the Federal government despite recent studies showing evidence of the substance causing tumors in animals as well as considerable human exposure to it at the present time (Perera and Petito, 1982). Each year approximately $350 million worth of the chemical is produced which helps understand why the industry would want to avert the ban.

The influence of the Formaldehyde Institute was realized when a top scientist at OSHA was given a termination notice due to his

stand against formaldehyde. The protection of public health was on the line, as public service personnel realized that each may be fired for doing the job well (Sun, 1981).

If OSHA and EPA fail to regulate formaldehyde under the present policy, they have to completely write a new policy. If a new policy is formulated, there is sure to be many conflicts with other agencies now advocating the present one. If OSHA indeed requires evidence of cancer in humans before taking regulatory action, it is particularly "bad news" for the estimated 1.6 million workers "potentially at risk from exposure to formaldehyde" (Sun, 1981).

The evidence against formaldehyde has been sufficient to prompt the Consumer Product Safety Commission to vote for a ban on urea formaldehyde foam insulation on February 22nd, 1982. Earlier in 1981, Canada banned the foam pending a review of additional scientific data. In that same year, the states of Massachusetts and Connecticut banned the use of the foam.

The case of formaldehyde in Canada involves some complicated legal issues. The government suspected the chemical of causing cancer as early as 1974. In 1977, the government approved the use of urea formaldehyde for insulation. As a result, many thousands of Canadian homeowners have an insulation which is not efficient, is a health risk, and is very expensive to remove or neutralize (Goar, 1984). The approval of the foam could have led to criminal charges against the officials who approved it, but there was a recluctance to charge civil servants (MacLeans, 1984).

The Consumer Affairs Minister of Canada was successful in obtaining $110 million to assist homeowners in making their structures safe. The government is paying a maximum of $5,000 per household to help control the gas releases.

At least 1.5 million persons live in about one-half million U.S. homes insulated with this type of foam. Since the insulation became popular, Consumer Products Safety Commission has received complaints from some 6,000 of those persons (Garmon, 1982). These homeowners have no other choice but to absorb the expense of foam removal or move out. Many face the reality of their property being devalued permanently. There has been no major move in the U.S. to get aid for these families.

Another area where formaldehyde has received a conviction is the public schools, colleges and universities over the nation. Since the chemical is used in biological specimens, it has been highly concentrated in school storage areas and classrooms. School officials have taken steps to remove all materials containing formaldehyde. Since 1984, the East Baton Rouge School Board has directed all schools to pack all materials containing formaldehyde and expedite their removal.

If the scientific community prevails in the formaldehyde issue, it is certain to be banned in all environments. The political issues will remain with us for some time or until epidemiological studies on the human population are completed.

Educational Implications

Educational implications of this issue would appear to follow the regular school health program guidelines: school health services, health instruction, and healthful school environment.

School Health Services. School personnel should become familiar with the multitude of symptoms this chemical can cause in students and teachers alike. Many teachers have resigned from their positions rather than be fired due to absence, or worse, to fear of being found incompetent. Some of those same teachers are now knowledgeable enough to educate school board members, officials and personnel about the matter.

The treatment of an illness due to chemical exposure will be difficult for years to come because of only a handful of detoxification centers which treat many of the chemically induced conditions. Examples of such centers are two HealthMed facilities in Sacramento and Los Angeles, California. Another similar center was established by Dr. Randall in Chicago, Illinois, and a third one by Dr. Rae in Dallas, Texas. Although some traditional physicians may not recognize the treatment, many insurance companies consider it a cost effective way to return individuals back to work.

However, more importantly, health professionals need to be educated how to identify and treat symptoms before an individual needs treatment, and to provide assistance in identifying methods of prevention.

Health Instruction. Health education curriculum provides a

mode of instruction about this issue. Within a community health or environmental health units, this complex matter may be discussed. Both identification of a potential problem and methods to combat a possible toxic condition may be addressed.

Healthful School Environment. Specific guidelines could be developed to maintain an appropriate physical environment for education purposes. Some points to cover would include:

1. To maintain air quality in a school/workplace setting, humidity levels should be maintained between 30-50% (Barner, 1988).

2. To provide adequate ventilation, access to open doors and windows must be available. A recommended level of air movement in a school setting is 10 to 30 cubic feet of fresh air per minute per student depending on activity to be performed in a given space (Mayshark et al., 1977).

3. To eliminate a potential health problem requires identification of the source. Many areas may be covered with appropriate paint or sealant available from specialty stores.

4. To purchase new products, awareness among school board members and others involved with purchases must be raised. New purchases should be based on content listing from the manufacturer. Solid wood furniture, natural untreated fabrics, and organic, pesticide-free foods may be purchased.

5. To remove formaldehyde, the manufacturer may be asked to apply heat, steam, or other removal process prior to shipment. Many products may also be aired out prior to placement in school or work environment.

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